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A Nuclear Energy Strategy to Preserve the Industrial Base Into the Twenty-First Century

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3105 94-08052



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Unclassified

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION Unclassified		1b. RESTRICTIVE MARKINGS	
2a. SECURITY CLASSIFICATION AUTHORITY N/A		3. DISTRIBUTION/AVAILABILITY OF REPORT Distribution Statement A: Approved for public release; distribution is unlimited.	
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE N/A		5. MONITORING ORGANIZATION REPORT NUMBER(S) Same	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) NDU-ICAF-93-F2		7a. NAME OF MONITORING ORGANIZATION National Defense University	
6a. NAME OF PERFORMING ORGANIZATION Industrial College of the Armed Forces	6b. OFFICE SYMBOL (If applicable) ICAF-FAP	7b. ADDRESS (City, State, and ZIP Code) Fort Lesley J. McNair Washington, D.C. 20319-6000	
8a. NAME OF FUNDING/SPONSORING ORGANIZATION	8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER	
8c. ADDRESS (City, State, and ZIP Code)		10. SOURCE OF FUNDING NUMBERS	
		PROGRAM ELEMENT NO.	PROJECT NO.
		TASK NO.	WORK UNIT ACCESSION NO.
11. TITLE (Include Security Classification) <i>A nuclear Energy Strategy to Preserve the Industrial Base Into the Twenty-First Century</i>			
12. PERSONAL AUTHOR(S) <i>Richard J. Haughton</i>			
13a. TYPE OF REPORT Research	13b. TIME COVERED FROM Aug 92 TO Apr 93	14. DATE OF REPORT (Year, Month, Day) April 1993	15. PAGE COUNT 32
16. SUPPLEMENTARY NOTATION			
17. COSATI CODES		18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)	
FIELD	GROUP	SUB-GROUP	
19. ABSTRACT (Continue on reverse if necessary and identify by block number)			
SEE ATTACHED			
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input checked="" type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS		21. ABSTRACT SECURITY CLASSIFICATION Unclassified	
22a. NAME OF RESPONSIBLE INDIVIDUAL Judy Clark		22b. TELEPHONE (Include Area Code) (202) 475-1889	22c. OFFICE SYMBOL ICAF-FAP

A NUCLEAR ENERGY STRATEGY TO PRESERVE THE INDUSTRIAL BASE INTO
THE TWENTY FIRST CENTURY

CAPTAIN RICHARD J. NAUGHTON

ABSTRACT

The National Energy Strategy of 1991/1992 provides only the broadest of outlines for a strategy to ensure a viable nuclear energy generation capability for electrical power. The FY 93 and FY 94 federal defense budgets provide minimum support to maintain a nuclear powered shipbuilding capability within the United States. These two industries are closely related and are vital strategic assets. The United States must implement a more comprehensive strategy to preserve the core design and production technologies of the nuclear power industry. This paper examines the background of both the commercial nuclear and nuclear shipbuilding industries, then proposes modifications to the National Energy Strategy and the Defense Department procurement strategy to save these industries.

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Table of contents

Overview *****	1.
Commercial industry background *****	1.
Navy nuclear power background *****	4.
Industrial base *****	6.
How much remains and where is it? *****	7.
The fragile industrial base. *****	9.
How bad is the industrial base? *****	10.
Where is the United States commercial industry going? *****	11.
What is happening in the rest of the world? *****	12.
What is the United States' current nuclear energy strategy? *	14.
Licensing reform *****	15.
Waste management and disposal *****	16.
New passive safety designs *****	18.
Changes required in the nuclear energy strategy. *****	19.
Public confidence *****	20.
Preserving the industrial base *****	20.
Cost control *****	22.
New technologies for waste storage *****	23.
Summary *****	24.

**"THIS NATION'S ENERGY STRATEGY IS BEING DEVELOPED BY
POETS, PHILOSOPHERS AND POLITICIANS. IS IT ANY WONDER
THAT WE ARE IN TROUBLE?"**

ROSS PEROT

Overview

During the 1950s and the 1960s the United States expended huge amounts of capital to find ways to harness the energy potential of nuclear fission. The Manhattan Project had been the most successful engineering endeavor of all time and the United States intended to capitalize on this technology. The commercial power industry and the Navy both pursued nuclear reactor technology. Over the next thirty years a strong industrial base emerged which produced more nuclear power reactors than the rest of the world combined.

Commercial industry background.

In the early 1960's, commercial nuclear power was foreseen as the world's answer to the finite supply of fossil fuels. The United States and the rest of the world anxiously placed orders for new nuclear power plants. Japan and France embarked on programs which would make them virtually energy independent by the turn of the century, a strategy these two countries still aggressively pursue.¹ The United States began to build reactors that were inexpensive and could be brought on line in just a few

¹ France currently develops seventy five percent of its electricity from nuclear power plants. Japan currently develops thirty five percent of its electricity from nuclear power and plans on doubling its capacity by 2010.

years. One of the first of these, the Haddam Neck plant, a 582 megawatt reactor operated by Connecticut Yankee, entered commercial operation in January of 1968 at a cost of \$92 million. Thrilled with potential panacea for power the utility companies ordered hundreds of reactors on a cost plus basis over the next few years.² Yet as excitement for the "final" solution escalated, apprehensions emerged.

Environmental concerns surfaced with respect to all of the nuclear reactors that were under construction. Organized opposition efforts led to the Calvert Cliffs vs. The Atomic Energy Commission decision which extended the requirement for an environmental impact statement to the construction of nuclear power plants.³ This was the first time that companies were required to provide environmental impact studies before beginning construction and would portend the future of nuclear energy.

In the mid seventies the Energy Reorganization Act divided the Atomic Energy Commission into two parts a Energy Research and Development Agency [precursor to the Department of Energy] and the Nuclear Regulatory Commission [NRC]. The intention of the act was to separate the development function [DOE] and the regulation function of the commission [NRC]. The environmental impact

² Geoffery Rothwell, "Can Nuclear Power Compete?", Regulation, Winter 1992

³ Rothwell

requirement significantly slowed the licensing process for new plants but the NRC was able to license plants in a reasonable amount of time. Then two events occurred that changed the entire licensing equation:

- Browns Ferry fire in 1975
- Three Mile Island incident in 1979

The licensing process, which had become increasingly difficult for several years, now became practically impossible. Escalating pressure from environmental and regulatory sources coerced utility companies into canceling orders for more than 100 reactors between 1972 and 1982.⁴ There has not been a new order for a commercial power plant since 1978.

What happened to the dream of energy independence?

The cost of building power plants spiraled due to increased regulation and licensing procedures. Consequentially an updated version of the 1968 Haddam Neck reactor, brought on line for cost of \$92 million, would have cost over \$4 billion in 1984.⁵ A modernized 1000 megawatt plant would not only be much more costly but also would take about twelve years to build. Where are those costs?

\$1 billion - regulatory changes during construction!!

⁴ Rothwell

⁵ Philip Bray, Vice President and General Manager, Nuclear power Systems Division, General Electric Company. Speech delivered at Nuclear Power Services Conference, Washington D.C. 1984.

\$1 billion - increased costs of construction in 12 years!!

\$1 billion - interest on construction bonds over 12 years!!⁶

No wonder not one new facility was under construction when it would cost nearly \$4 billion for a \$1 billion power plant. The commercial industry was in trouble and clearly a new direction and strategy were required.

Navy Nuclear Power background.

The Navy nuclear power program was able to maintain its momentum since it had not experienced an incident like Three Mile Island and the cold war was still going on. As long as the "Evil Empire" still existed the Navy would always need newer and better submarines and replacement aircraft carriers for the fossil fueled conventional carriers that were reaching their fifty year service life. The Navy was able to build nuclear submarines at the rate of three a year and produce two nuclear carriers every four years. The industrial base was exceptionally strong with two very large nuclear shipbuilding companies, Electric Boat operated by General Dynamics and Newport News Shipyard and Dry Dock operated by Tenneco, competing for business and employing thousands of skilled nuclear workers. In addition the Navy commissioned two competing laboratories to do research on improving technologies, Bettis, a Westinghouse subsidiary, and KAPL, a General Electric subsidiary. These four major conglomerates engaged a host subcontractors and wholly owned

⁶ Philip Bray

subsidiaries to develop new technologies and improve on the old. Technological advancements were then used in the design and production of commercial plants. This synergy benefitted both the Navy and the industry.

In 1989 the collapse of the Warsaw Pact and the eventual break up of the Soviet Union caused serious reflection as to the level of defense required. The Cold War was over and the United States needed to figure out how to win the peace. If the Soviets were not going to deploy their ballistic missile submarines the United States surely didn't need a hundred Los Angeles class submarines to follow them around. If the Soviets were not going to deploy their Navy out of their coastal waters, how many carriers were required? In the days of shrinking defense budgets the first thing targeted were big ticket items such as nuclear carriers and submarines. The Seawolf submarine[SSN 21] was all but scrapped and the newest aircraft carrier[CVN 76] was under serious scrutiny.

It appears that in the early 1990's, both the Navy and the civilian nuclear industry have been priced out of the market. If the ability to build nuclear power plants and nuclear powered ships is lost the United States may not be able to afford to reconstitute the industrial base required to reenter the field. Thus the key questions addressed in this paper are:

- 1] What is the current Nuclear Power strategy and is it the right one?
- 2] Is it possible and/or essential to save the nuclear industrial base that has been developed over the past forty years ?

Status of the nuclear industrial base.

A new commercial nuclear power plant has not been ordered since 1978. To say that the commercial industrial base has declined would be an obvious understatement. The companies that were the primary and secondary suppliers to the commercial nuclear industry have long since changed market focus or gone out of business. The only current nuclear industrial base exists to support the Navy's nuclear shipbuilding at Electric Boat and Newport News. With the drawdown in submarine and surface ship procurement this industrial base is extremely fragile. The overall defense industrial base has declined significantly in the last decade even during a period of intense defense buildup. According to a study by the Center for Strategic and International Studies, the number of manufacturing establishments providing manufactured goods to the Defense Department declined by nearly seventy per cent in the 1980s. Additionally, the Small Business Administration estimates that thirty-five hundred to

four thousand small defense contractors go bankrupt every year.⁷ The demise of the overall defense industrial base is happening quickly and the nuclear power industrial base is shrinking at an even faster rate.

How much of the industrial base remains and where is it ?

Without the continuation of Navy nuclear shipbuilding the United States will have no industrial base or infrastructure to build on if a need exists to expand our commitment to commercial nuclear power. The former Secretary of Defense Dick Cheney in one of his last days in office expressed concern that "We haven't resolved the nuclear submarine issue yet. There are really difficult questions about how you maintain an adequate industrial base ...and still recognize that you don't need eighty five nuclear attack submarines."⁸ The question is broader then just maintaining the submarine building base and preserving it for possible future use. The former Secretary of the Navy H. Lawrence Garrett stated in testimony to the Senate Armed Services Committee that if we lose the industrial base we have developed over the last forty years we will not be able to overhaul and refuel the submarines, surface ships and aircraft carriers that

⁷ Kenneth L. Adelman and Norman R Augustine, The Defense Revolution, Institute for Contemporary Studies, San Francisco. Ca. 1990, p 161

⁸ Defense Daily, January 5, 1993.p1

the American people have invested tens of billions of dollars in.⁹

The most graphic examples of what has happened to the nuclear industrial base during the last few years are the complications surrounding the production of the two newest nuclear aircraft carriers currently under construction at Newport News. In order to take advantage of economies of scale and modular shipbuilding techniques nuclear aircraft carriers have been constructed in pairs for the last twenty years. When CVN 72 and CVN 73 were contracted for in the early 1980's a strong nuclear and defense industrial base existed. These ships were delivered ahead of schedule and were the embodiment of technical excellence. In 1988 the contract was let to build CVN 74 and CVN 75. At the same time the demise of the defense manufacturing industry, previously alluded to, began to have serious effect. Items which were readily available for CVN 72 and CVN 73 now became long lead time items for CVN 74 and CVN 75. The nuclear industry sub tier businesses experienced a large number of plant closings, buyouts and consolidations. Lead times for critical components such as turbine generators, compressors, steam turbines, fire pumps , and main propulsion components had significantly lengthened.¹⁰ These two carriers will not be as easy to complete and the costs will

⁹ H. Lawrence Garrett, Senate Armed Services testimony 22 May 1992.

¹⁰ NAVSEA response to GAO inquiry, 22 July 1992, p3.

escalate significantly. The building of submarines has essentially stopped until late in the 1990's when the next generation of submarine, the Centurion, may or may not be built. Two Seawolf submarines are currently authorized and if a third is not authorized in the next year long lead time sub tier vendors will simply disappear. Only the aircraft carrier building program remains to carry the nuclear industrial base into the next century. The industrial base has deteriorated to the extent that, among other problems, critical pipe required for completion of engineering plants must be imported from Germany and Britain then upgraded for nuclear use.¹¹

The fragile industrial base.

Much controversy exists regarding the need for the Navy to build another nuclear powered carrier. In 1991 the decision was made to proceed with procurement of CVN 76 beginning in FY 96. As the problems with lead time and industrial capacity became apparent the Navy requested to move construction to FY 95 with advance procurement beginning in FY 93. The industrial base had deteriorated to the point that many subcontractors and suppliers would not be in business if they had to wait until FY 94 to begin production on long lead time items.

" If we do not start building this aircraft carrier this year, we may not be able to build it. We may not be

¹¹ NAVSEA report p3.

able to afford it in future years."

Secretary of the Navy, 26 June 1992

The industrial infrastructure has become so weak that studies showed that delaying funding could jeopardize the entire contract. If the carrier nuclear cores are not awarded in FY 93 the manufacturer will be forced to shut down the front end of his production line increasing cost by forty to fifty percent when the line is reopened. Some long lead time items require five to seven years to build even with a strong industrial base. Given the current situation these items will probably not be available at all to begin construction on CVN 76. The Navy will be forced to use spare parts bought to support overhaul and maintenance of the existing carrier fleet for new construction.¹² This is a very dangerous practice with the potential debilitating effects on national security in time of conflict. There are no spares bought strictly as a wartime reserve. Simply put - there will not be repair parts to maintain the ships which have been the centerpiece of the Navy since the battle of Midway in 1941.

How bad is the industrial base?

The industrial base has atrophied to such an extent that the FY 1993 funds for CVN 76 represent the only business available with which to sustain it. Termination of the Seawolf [SSN21] program in 1989 resulted in cancellation of all nuclear component work.

¹² Secretary of the Navy Memorandum to Congress, 10 September 1992.

No commercial market exists to preserve these capabilities.¹³ An integral part of our nuclear strategy must be preservation of the industrial base developed over the last forty years.

There are about 5000 items, provided by sub tier vendors, which are unique to nuclear submarines, of these 150 have no second source. If the United States decides not to continue building submarines, these sub tier vendors will disappear forever.¹⁴

Where is the United States commercial nuclear industry going?

By 2010 projections indicate that forty one percent of the primary energy consumed in the United States will be by electricity. This equates to an increased requirement of 200,000 megawatts in electrical generating capacity by 2010.¹⁵ Currently about twenty percent of the

United States electrical power
is supplied by nuclear energy.

The stricter emission
standards the 1990 Clean Air

Act imposes on coal fired plants will make the continued use of older coal fired plants difficult, if not impossible. Since coal is the largest single fuel used in electricity generation it

IF WE DON'T DO OUR JOB THERE
WON'T BE AN INDUSTRY.

Ivan Selin, Chairman NRC

¹³ SECNAV, p.2.

¹⁴ RADM J.S. Shipway, PEO of Navy Submarine Programs, 2 March 1993.

¹⁵ National Energy Strategy, "Powerful Ideas for America", US Government Printing Office, Washington DC, 1992.

would be foolish not to plan on some new nuclear generating capacity.¹⁶ The nuclear plants built in the sixties and the seventies were licensed for forty years and many of them will be coming up for renewal in the next few years. To date no plant has successfully completed the license renewal process. Before new plants can be commissioned we must find

HALF THE REACTORS OPERATING ARE SITTING ON SITES THAT BY TODAY'S STANDARDS ARE NOT LICENSABLE.

out if the older ones can get their licenses renewed. Many experts think this will not happen without a significant change in the public mindset.

"The licenses under which the nation's 111 nuclear power plants now operate will begin expiring in the year 2000. To renew or not to renew, that is the question, thereon may hinge the future of the nuclear industry"¹⁷

There is good news and bad news in the future of commercial nuclear power - a real need exists for nuclear power in the next century but a coordinated strategy must be developed.

What is happening in the rest of the world?

Many countries have committed to commercial nuclear power and are

¹⁶ Modern Power Systems, "Nuclear Sector Foresees Future Role", Miller Freeman Publications, San Francisco, Ca., Dec. 1991.

¹⁷ Margaret E. Kris, "Nuclear Wind-Down, National Journal, 8/31/91, p 2081.

making it work. The strategy of the French appears to have been the most successful. They have taken the United States Pressurized Water [PWR] design and made it the standard for all of France. Seventy five percent of the electricity used in France is generated by its fifty seven PWR reactors. France is able to export fourteen percent of the power its nuclear plants produce to the European electrical grid.¹⁸ Germany develops forty percent of its electricity by nuclear power and is looking for ways to either dismantle or bring back on line the Soviet designs in the former East German state.¹⁹ Japan is currently generating thirty five percent of its electricity by nuclear power and plans to double that by the year 2010.²⁰ Nearly half of Korea's electrical power is generated by its ten nuclear reactors. There are plans to bring five more reactors on line in Korea by 2006.²¹ Why are these and other countries able to bring nuclear plants on line and keep them operating? Primarily it is because they have developed a unity of purpose and settled on one or two designs. In contrast, little was done to ensure consistency of design in the United States, as long as the plant was able to meet the stringent safety and environmental

¹⁸ G. de Montravel The French Perspective, 1991 IEEE PES Winter Meeting, New York, NY, February 4, 1991.

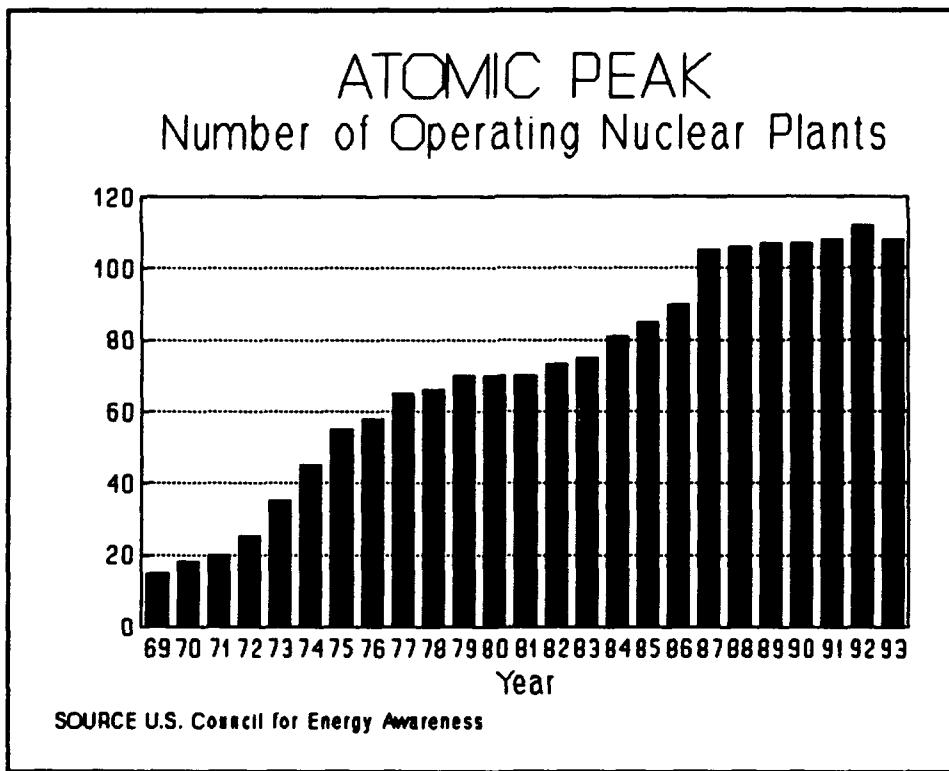
¹⁹ Dr. Ing. Manfred Timm, IEEE Power Engineering Review, May 1991.

²⁰ Commercial Nuclear Power, 1991, Energy Information Administration, U.S. Department of Energy, Washington ,DC.

²¹ MPS Review, Dec 1991.

requirements the NRC no one seemed to really care if there was a consistency of design.

Recently the last nuclear power plant owned by a private utility was licensed to begin testing and is expected to begin full commercial operation next summer. This plant is known as the Comanche Peak II and is owned by the Dallas based TU Electric Company. This will bring the total of currently operating nuclear power plants to 109 producing twenty two percent of the country's total electrical power.²²



The chart above shows that the number of nuclear power plants

²² Washington Post, 5 February 1993, p. F1.

coming on line has peaked and the total number is actually decreasing.

What is the current Nuclear Energy Strategy?

The current strategy is a broad based policy that has three basic pillars.

- 1) Reform the Nuclear Licensing Process
- 2) Manage Properly and Dispose of High-Level Nuclear Waste
- 3) Develop New, Passively Safe Designs²³

This strategy was developed by the Bush administration and provides a basis that must be expanded upon if we are going to maintain our ability to augment or even maintain our current nuclear generating capacity. -

1) Licensing Reform-

The issue of licensing has been the bane of the nuclear industry for the last fifteen years and will continue to be until the 1992 Energy Policy Act can be implemented. This legislation will simplify the procedures. The Bush administration and the NRC combined the technical and the institutional issues into one procedure. The thrust of the legislation is to provide preapproval of both the reactor sites and designs enabling the NRC to combine construction permits with operating licenses. The

²³ National Energy Strategy, p.19.

NRC felt it had the authority to operate in this permit/ license format throughout the 1980s. Then, in 1989, the NRC published its construction and licensing reform rule. Before approval could be given to any project the U.S. Appeals Court of the District of Columbia struck down the provision for issuing a combination construction permit and operating license.²⁴ This court decision was reversed through legislation and the NRC under the Energy Policy act of 1992 was given the explicit authority to issue a combination construction permit and operating license. This type of licensing would include strict provisions for inspections during construction to ensure compliance with specifications.²⁵ It remains to be seen if the Clinton administration will support this act or take a stand to limit commercial nuclear power.

2) Waste Management and Disposal

The National Energy Strategy, inter alia, states all federal agencies must fully support the Department of Energy's efforts to site and license a permanent waste repository and monitored retrievable storage facility. The long term site will permanently store spent fuel and other high level waste. The retrievable storage facility will store high level waste but the waste must be accessible and retrievable within certain parameters. In 1987, in order to reduce federal spending on site

²⁴ Rothwell, p.72.

²⁵ Regulation, 1992

exploration, legislation was introduced to limit exploration to one site. This legislation and further provisions adapted by Congress (which became known as the Nuclear Waste Policy Amendments Act of 1987) ensured that the only qualified site was Yucca Mountain, Nevada. The act linked the construction and operation of monitored retrievable storage facilities to licensing and construction of the long term repository.²⁶ State officials of Nevada have continuously sought to prevent the DOE from conducting any tests or construction at Yucca Mountain.

The state of Nevada and others have argued that the potential for earthquakes and volcanic eruptions make Yucca Mountain unsafe for the storage of high level waste. However, the director of the seismology lab at the University of Nevada-Reno recently presented a study that seems to provide definitive evidence that there hasn't been a significant earthquake in the Yucca Mountain area in the last 10,000 years and perhaps not in the last 100,000 years.²⁷ Clearly there is marked disagreement among experts about the Yucca

Mountain site. The debate has so frustrated the DOE that it has put off the opening of the long

The Nuclear Waste Policy Amendments Act provisions that link medium term storage construction to long term repository should be repealed.

Geoffery Rothwell, Center for Economic Policy Research

²⁶ Rothwell, p. 72.

²⁷ Washington Post, 8 December, 1991.

term repository until 2010 and the monitored retrievable storage facility until at least 1998. Until that time the high level waste is stored throughout the country with many plants storing their spent fuel on the plant site. Until the long term and retrievable storage debate can be resolved a coherent nuclear energy strategy will be difficult. By delinking medium and long term storage, more solutions to the spent fuel waste problem will become available.²⁸ Some think that storing spent fuel at plant sites that have been shut down, for one reason or another, could provide a temporary solution to the storage problem until legislation can be enacted to delink the storage issues. This would reduce traffic of hazardous material on the roadways and minimize public exposure.

3) Develop New Passively Safe Designs

A complete loss of cooling water is one of the worst type of reactor accidents. In this situation the water that flows through the reactor core to remove the heat generated in a critical reactor is for some reason stopped, similar to the type of incident that occurred at Three Mile Island. In that emergency the operators did not take the proper action resulting in core damage. Containment prevented any contamination of the surrounding area. Since that time, personnel sufficiently knowledgeable in engineering and reactor safeguards are required at each plant at all times. In addition designs are being

²⁸ Rothwell, p.73.

studied which have passive systems that recognize loss of cooling water and provide cooling water without the use of any pumps. Some of these designs involve storing hundreds of thousands of gallons above the reactor vessel.²⁹ The next generation of reactors is currently being developed by American industry. Advanced Pressurized Water Reactors (APWR) are being developed by Combustion Engineering and Westinghouse. Both of these companies expect to have design approval in the next two years.³⁰ General Electric has developed the Advanced Boiling Water Reactor (ABWR) and is constructing two of them in Japan that are expected to come on line in 1996. The ABWR is currently being reviewed by the Nuclear Regulatory Commission as the lead candidate for certification as a preapproved U.S. standard design under the Department of Energy's advanced reactor design certification program.³¹ All of these designs include some type of passive safety system which will prevent core damage for an extended period of time without any operator action.

What needs to be changed in our Nuclear Strategy?

There are several areas that the nuclear portion of the National Energy Strategy neglects.

- Gaining the public confidence
- Preserving some portion of the nuclear industrial base

²⁹. Nuclear News, "New Reactor Designs", September 1992.

³⁰ Nuclear News, "The New Reactors", September, 1992. p.66.

³¹ Nuclear News, p.71.

- Providing nuclear generating capacity at reasonable cost
- Discovering new technologies to store high level waste

Gaining Public confidence - Gaining the public confidence needs to be a coordinated strategy. The former director of the Nuclear Regulatory Commission, Mr. Carr had a poor relationship with the press and even worse with public interest groups. Carr was often accused of promoting nuclear power at the expense of public input and public safety.³²

Mr. Carr was replaced by Ivan Selin in 1991. Mr. Selin is a successful businessman with a doctorate in electrical engineering from Yale University. As a former Undersecretary of State, he has a wealth of experience in public relations. His first moves were to engage the public and make them part of the NRC process. His touch can be seen in the recent efforts by the NRC to operate in a more public venue. Television advertisements which emphasize the positive aspects of nuclear power are a product of this new spirit of cooperative engagement. Public confidence must be won before the renewal of licenses for currently operating plants becomes an issue or any legislation is implemented to couple construction permits to operating licenses.

No news is good news and no journalists is better "

NRC Chairman Carr, October 1990

³² "Nuclear Wind Down", p.2083.

Preserving the Nuclear Industrial Base - This may be the hardest part of the strategy. The authorization of 832 million dollars in the FY 93 defense budget to begin advance procurement of for CVN 76 will significantly help preserve the industrial base. However, this may only delay the problem for a few years. One of the popular themes the Clinton administration's new defense team is espousing is called " Selective low-rate procurement". Under this type of system certain critical technologies would be preserved. These technologies would be preserved even if it means sustaining a rate of procurement that exceeds short term needs. When Secretary of Defense Aspin was chairman of the House Armed Services Committee he stated in a speech to the American Defense Preparedness Association - "Portions of the shipbuilding industry are prime candidates for this approach. In the highly specialized area of naval nuclear propulsion, for example, our production base has already contracted to sole suppliers for key components. For these remaining suppliers there is a minimum level of orders without which they cannot stay in business. Some have estimated this minimum level to be one naval reactor per year. But our construction program doesn't call for a reactor per year.If we want to use nuclear propulsion in future ships, we have to ensure these suppliers remain viable."³³ It appears this is the only strategy which will keep the naval nuclear industry viable and provide at least a baseline should commercial nuclear

³³ Rep Les Aspin, Chairman House Armed Services Committee, Speech to American Defense Preparedness Association, February 12, 1992.

industry endure. It seems entirely possible that the nuclear shipbuilders will consolidate under one management. General Dynamics is consolidating their position and is selling most of their defense related divisions. A buy out of General Dynamics Electric Boat Division by Tenneco is a very real possibility. If this consolidation does not occur the possibility of a government owned and contractor operated nuclear shipbuilding industry [GOCO] must be vigorously explored.

Nuclear Energy at Reasonable Cost - When a commercial reactor cost two to three times more to build in the United States than Europe or Japan it is going to be very difficult for nuclear power to compete with fossil fuels [coal or gas]. The below chart shows that current construction and licensing procedures make it nearly impossible for nuclear power to compete.

NUCLEAR AND COAL FIRED COST OF PRODUCING ELECTRICITY

NUCLEAR COST PER KWH

COAL FIRED COST PER KWH

REGION	CAPITOL	OPS& MAINT	FUEL	TOTAL	CAPITOL	OPS& MAINT	FUEL	TOTAL	RATIO
EASTERN	47.9	6.1	7.1	61.1	21.7	4.5	28.8	54.9	.89
CENTRAL	47.6	6.6	7.1	61.3	21.4	5.2	17.8	44.4	.72
"BEST"	31.3	6.6	7.1	45.0	21.4	5.2	17.8	44.4	.99
MOUNTAIN	46.5	6.3	7.1	59.8	21.1	4.2	15.3	40.6	.68

SOURCE: REGULATION, WINTER 1992

Currently using the most optimistic forecast nuclear cost per kilowatt hour is comparable to coal fired plants only using some very aggressive assumptions. These assumptions are:

- Cost for new reactors will be equal to the cheapest of the large reactors finished in late 1970's and early 1980's
- Standardized and modular construction will reduce the cost of engineering and construction services
- Construction time will be six to seven years
- Reactors will be operated in two year fuel cycles at eighty percent capacity
- Operations and maintenance cost will be lower than in the 1980's³⁴

These assumptions indicate that nuclear power can produce electricity at the same price as natural gas and slightly lower than coal fired plants after the latter comply with the 1990 Clean Air Act. There is going to have to be a serious shift in regulating policy for nuclear power to compete with currently available fossil fuels.

New Technologies for Waste Storage - With the delay in opening of the Yucca Mountain facility until 2010 discovering new ways to store high level waste is a priority. Unless some innovative ways to store waste emerge soon there won't be a commercial nuclear industry. Nuclear utilities which have paid six billion

³⁴ Rothwell, p.71.

Given the market failures in the nuclear power industry and the regulatory responses to them, forecasters have found that nuclear power will be economically viable only if the nuclear industry and its regulations change.

Geoffrey Rothwell, Center for Economic Policy Research

dollars into a waste disposal fund are becoming impatient with the Department of Energy, they feel they have already paid to have the waste problem solved.³⁵ A study by the University of Southern California Institute of Safety and Systems Management recommends that the entire Yucca Mountain project be shelved and new strategies such as permanent above ground storage pursued. Utilities are running out of space in their on site water storage pools and some are currently storing spent fuel above ground.³⁶ The DOE needs to engage in a program of examining alternatives to Yucca Mountain.

The Nuclear Industry regards the lack of a permanent solution to the waste disposal issue as the biggest single obstacle to the development of new nuclear power plants.

Washington Post, 2 February 1993

³⁵ The Washington Post, February 2, 1993, p A9.

³⁶ Washington Post, February 2, 1993 , p.A9.

Summary

The United States must pursue a more coherent and expanded nuclear energy strategy if it is to remain the world leader in nuclear technology. The Clinton administration has an opportunity to keep the nuclear industry viable but it will take a combined strategy by the Energy and Defense Departments. If the new Secretary of Energy, Hazel O'Leary, continues with the vision of the 1991 National Energy Strategy and finds a solution to the waste disposal problem then commercial nuclear power may survive. It will be up to the new Secretary of Defense, Les Aspin, to implement his plan of "Selective Low Rate Procurement" to preserve the diminishing industrial base. With out the aggressive commitment of government there won't be a United States commercial nuclear power industry or a nuclear shipbuilding industry by the year 2000.